20-10 SURFACE FAULT RUPTURE DISPLACEMENT HAZARD INVESTIGATIONS

Introduction

Structures crossing fault zones may be subjected to surface fault rupture displacement hazards (SFRDH). The evaluation of the potential for SFRDH shall be conducted as part of the work in preparing Structure Preliminary Geotechnical Reports, Preliminary Foundation Reports and Final Foundation Reports at locations:

- where any portion of a structure falls within California Geological Survey (CGS) Fault-Rupture Hazard Zones [1] (Alquist-Priolo Earthquake Fault Zones).
- outside CGS Fault-Rupture Hazard Zones, where the existence of a SFRDH due to a seismogenic fault as defined by the Caltrans California Seismic Hazard Map [2] is suspected.

Caltrans Geotechnical Services will make the final determination if new or suspected fault sources not included on the CGS Fault-Rupture Hazard Zone or Caltrans California Seismic Hazard Map must be considered.

Responsibilities

Projects Designed by Caltrans:

The Project Geologist/Geotechnical Engineer in charge of the foundation investigation (Project G/GE) shall be assigned lead responsibility for determining the need for site-specific SFRDH study and for developing SFRDH recommendations. To ensure cross-functional input, a Project Seismic Hazards Meeting shall be held to assess potential SFRDH hazards, ascertain whether SFRDH should be considered for design, and to determine the scope of any needed SFRDH studies. Attendees should include the Project G/GE, the Seismologist from Earthquake Engineering, and the Bridge Project Engineer.

Projects Designed for Caltrans by External Entities:

The Caltrans Geologist/Geotechnical Engineer responsible for oversight of the project (Oversight G/GE) shall be assigned lead responsibility for determining the need for site-specific SFRDH study, following a Project Seismic Hazards Meeting (as described above). Meeting attendees should include the Project Oversight Engineer, the Oversight G/GE, the

Seismologist from Earthquake Engineering, the Project G/GE, and the Bridge Project Engineer.

Methodology

If the decision is made to conduct a site-specific SFRDH study, the procedures as outlined in CGS Note 49 [3] shall be followed. The SFRDH study shall typically be conducted in coordination with the preliminary foundation investigation and include a field visit and the review of aerial photos and geological maps to identify if traces of a fault may cross the structure. If the trace of a fault is identified in the field, then a minimum horizontal setback of 50 feet from the trace should be considered as having potential for SFRDH.

Surface fault rupture displacement offset shall be estimated deterministically using the magnitude of the Maximum Credible Earthquake for the identified fault. This is consistent with Caltrans Seismic Design Criteria [4], where a deterministic approach is adopted for estimating seismic ground motions. Probabilistic evaluation of fault rupture displacement hazards is still the subject of ongoing research and site-specific field data are not generally available at this time.

If the potential for the trace of a fault to cross the structure or proposed structure alignment is established, then the fault rupture displacement offset for design shall be estimated from the Wells and Coppersmith correlation [5] or any updates. This correlation relates fault length with earthquake magnitude and maximum or average rupture displacement for a fault. The average displacement offset shall be the basis for the design of structures. The horizontal and vertical components of the displacement offset may be determined from the style of causative fault, if reliable field evidence for a better appraisal of the components is not available.

The fault rupture potential, the need for further study, and an estimate of the offset shall be addressed in the preliminary and final foundation reports [6].

Project Impact

Once the need to consider fault rupture has been established for a project, the impact on project scope, schedule, and cost shall be determined and appropriate action taken as established elsewhere in Caltrans guidance material.

References

1. California Geological Survey (2003), *Fault Rupture Hazard Zones*, Special Publication 42, 47p. http://www.consrv.ca.gov/CGS/rghm/ap/index.htm
2. Caltrans California Seismic Hazard Map. http://www.dot.ca.gov/hq/esc/earthquake_engineering/Seismology/seismicmap.html
3. California Geological Survey (1996), *Guidelines for evaluating the hazard of surface fault rupture*, CGS Note 49, 4p. http://www.consrv.ca.gov/cgs/information/publications/cgs_notes/note_49/note_49.pdf
4. California Department of Transportation (2004), *Seismic Design Criteria*, Version 1.3. http://www.dot.ca.gov/hq/esc/techpubs/manual/othermanual/other-engin-manual/seismic-design-criteria/sdc.html
5. Wells, D., and K. Coppersmith (1994), *New empirical relationships among magnitude, rupture length, rupture width, rupture area, and surface displacement*, Bulletin of the Seismological Society of America, Vol. 84, pp 974-1002.
6. California Department of Transportation, *Guidelines for Structure Foundation Reports*, version 2.0 (2006)

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